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SEMI-ANNUAL PROGRESS REPORT

ON

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COMPUTATION OF BROADBAND MIXING NOISE FROM TUBOMACHINERY

PERIOD COVERED BY THIS REPORT

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During this reporting period a paper "Discretization errors inherent in finite difference solution of propeller noise problems" was presented at the AIAA 13th Aeroacoustics Conference. This work focuses on the phenomena of dispersion and spurious acoustic radiation in calculating propeller noise using finite difference method. The same phenomena will also affect computational solutions of turbomachinery noise problems. This paper has now been accepted for publication in the AIAA Journal. It is anticipated to appear in print early 1992.

A paper entitled "Radiation boundary condition and anisotropy correction for the Helmholtz equation" has been completed. It has been submitted for publication in the Journal of Computational Physics. This work discusses the formulation and implementation of a set of improved radiation boundary conditions for acoustic wave solutions based on the Helmholtz equation. The improved radiation boundary condition is based on the asymptotic solution of the governing finite difference equation. When a square or rectangular grid is used to solve acoustic wave problems by finite difference methods anisotropy is introduced. The wave amplitude and propagation characteristics are directional dependent. This is illustrated and clarified in the paper. A way to correct this anisotropy in the computed solution is proposed. It is shown that the correction factor is extremely effective even when very complex noise sources are involved.

Progress has also been made in the development of an optimized higher order algorithm for finite difference solutions of acoustic problems. This new scheme ensures that the wave propagation characteristics of the finite difference equation are the same as those of the partial differential equations

(Euler equations). This aspect differs greatly from traditional CFD approach. Work on this part of the research program will continue in the remaining period of the grant.